SIEMENS

Fibersim

Renault F1 Team

Elite racing team accomplishes two weeks of analysis data transfer in two hours using Fibersim

Industry

Automotive and transportation

Business challenges

Quickly and easily transfer load and analysis data to detailed design software

Reduce design and manufacturing cycles to meet strict delivery times while ensuring part quality and consistency

Create consistently accurate plies based directly on analysis data

Keys to success

Fully automate the transfer of data from FEA software to the CAD system

Eliminate tedious, manual, non-engineering tasks

Build in additional analysis cycles that provide critical performance enhancements

Results

Transferred complete upper and lower chassis model to detailed design in two hours, a process that used to take two weeks

The Renault F1 Team R28 racing car in action. Fibersim software was used to support the entire product development process for the composite parts on the car, including transferring analysis data to detailed design during the conceptual design phase.

2008 Renault F1 Team achieves consistent ply design quality when transferring data from FEA to the CAD system

Early design work on many Formula One cars based on analysis data

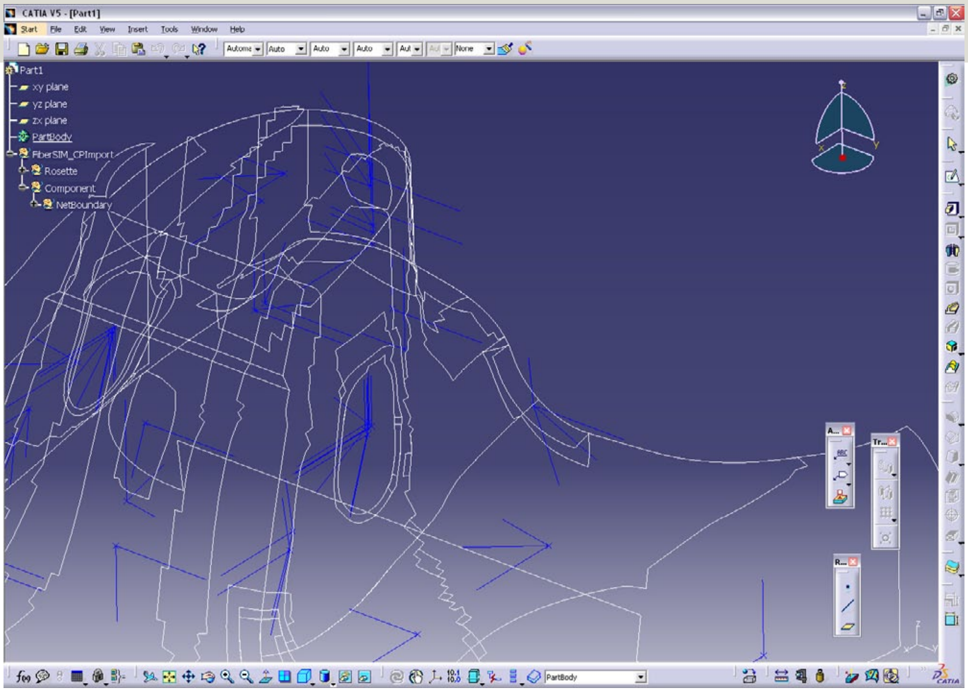
Each racing season, the Lotus F1 Team is under intense pressure to meet challenging deadlines when developing its complex composite racing cars. The Team (racing as the Renault F1 Team in 2008) needed to completely re-design, manufacture, analyze and test its cars in only sixteen weeks or risk stringent penalties from the Fédération Internationale de l'Automobile (FIA), or worse, the loss of an entire racing season. As a result, the team constantly strived to reduce cycle times and eliminate errors to achieve a competitive edge.

Much of the early design work on Formula One cars is based on analysis data compiled from aerodynamic wind tunnel testing, computational fluid dynamics (CFD) simulations and finite element analysis (FEA)/load testing. As a result of these tests and in an effort to create parts that are durable, crash protective and meet all specifications, analysts begin to create design data with FEA software by defining composite part thicknesses, boundaries, ply orientations and sequences. However, in order to begin the detailed design process,

Results *(continued)*

Achieved consistent ply design quality when transferring data from FEA software to CAD system, with 100 percent of plies correctly designed

Saved more than 60 percent total development time



With the semi-automated approach to transferring analysis data to detailed design, the FEA ply boundary and geometry data was imported into Catia® software, ultimately appearing as a series of points and rough, jagged boundaries in the CAD software that required considerable clean-up prior to being used by the design team.

all this engineering data must be transferred to the detailed design team as efficiently as possible to ensure the plies can be re-created in computer-aided design (CAD) software based on the work that has already been accomplished.

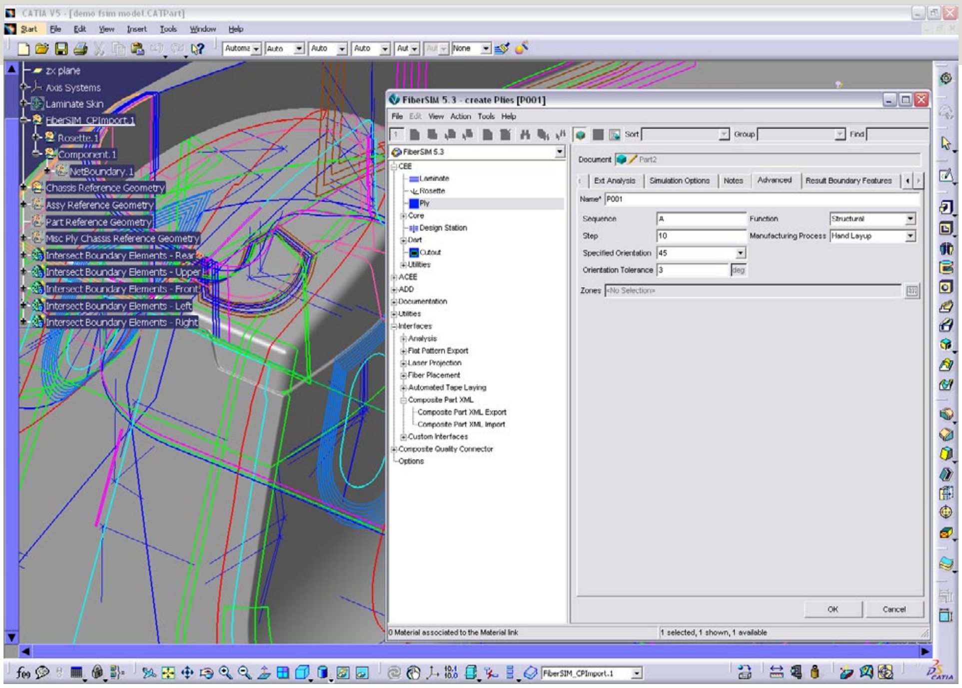
It is no small task to efficiently transfer laminate configuration data from FEA analysis tools to detailed composite design and CAD software. Prior to finding a successful, fully automated approach during 2008, the Renault F1 Team used both a manual and a semi-automated approach with little success.

Challenges in analysis design transfer

The manual data transfer approach, which used printed views of each ply from Patran® analysis software for manual interpretation and freehand modeling in the CAD system, proved to be a difficult process that took up to two weeks to accomplish and an additional two weeks to get the CAD geometry into a usable form. This method forced designers to re-create ply lay-up data in the 3D CAD environment, thereby consuming valuable development time and only enabling an approximate re-creation of the intended FEA ply boundaries.

In an attempt to improve upon the manual approach, the team graduated to a semi-automated method that exported analysis lay-up files to a native CAD file. The result was a series of points and rough, jagged boundaries in the CAD software, which again required significant clean-up. In addition, the resulting single "whole chassis" data file wasn't usable in the detailed design phase, which requires individual part data files in CAD.

A data translator was required to manually break up the whole file, discretionally removing redundant plies to leave just the correct subpart laminate – a highly error-prone and time-consuming task. When tested on the roll hoop, 20 percent of the plies were incorrectly specified. Even worse, part weight was often inconsistent because of the errors, affecting the performance of the test cars. Design engineers were never certain if they created plies that truly reflected what the stress team



Using a fully automated approach to analysis data transfer, the full laminate is defined using Fibersim, which is integrated with the Catia CAD system. Through the use of the Fibersim curve utilities and its ply definition interface, single boundaries provided by the FEA software are populated into groups with ply drop-offs.

needed to accomplish with each part. It was also not clear whether the final parts would perform consistently from car to car since the process was not truly automated. The design team needed a simpler, more accurate starting point for detailed design, but none of their existing tools could effectively produce this data efficiently and accurately.

Creating a seamless link between analysis and detailed design

Based on its success working with the Fibersim™ portfolio of software for composites engineering on the previous four generations of racing cars, the Renault F1 Team turned to Vistagy, Inc. (which was subsequently acquired by Siemens PLM Software) to resolve its data transfer problems when designing the car. The team's goal was to seamlessly transfer chassis analysis data directly to the CAD model using Fibersim. This would provide a very significant head-start on the detailed design process and potentially save several days of development time.

Engineers at Siemens PLM Software ultimately created a software utility that enabled the team to automatically transfer the data directly from the analysis software into Fibersim – which is fully integrated into the CAD system. Using Fibersim, the engineers could automatically consume the analysis data without having to engage in a manual translation process. They found it easier and quicker to programmatically calculate ply boundaries and orientations than starting from scratch. The team simply used the boundaries that were directly imported and quickly created the designs.

By implementing the utility, the team accomplished two weeks of data transfer and design in two hours. Large, single lay-up files were divided into component laminates and imported to Fibersim in seconds. The rapid translation times allowed engineers to transfer complete, stand-alone models, saving 97 percent of the time compared to the previous manual approach.

Solutions/Services

Fibersim
siemens.com/plm/fibersim

Customer's primary business

Lotus F1 Team (formerly Renault F1 Team) is 100 percent owned by Genii Capital. Together with the backing of Group Lotus, the team embodies Enstone's proud motorsport heritage and Genii Capital's vibrant vision for the sport's future, driven forward by a singular goal: victory in the FIA Formula One World Championship.
www.lotusf1team.com

Customer location

Enstone
England

High-quality data was another benefit of using Fibersim. Because the models were based on actual analysis data, the final geometry was more accurate. In fact, the first time the team ran the software it achieved a 100 percent ply success rate – meaning virtually every ply imported into Fibersim was perfect. That meant highly skilled engineers didn't have to spend days handpicking curves and chaining them together. The boundaries could be automatically imported, reducing development time for creating the ply models and sequences by 60 percent.

The design data was now based on the actual mesh edge, so the boundaries were exactly the same as the analyst envisioned them. Using Fibersim enabled the team to capture the data as an original source for the geometry, and helped engineers associate all annotations and notes directly to the plies in the models. But even more importantly, because the transfer process was so swift, engineers determined they could engage in another week of analysis testing cycles to further reduce chassis weight and increase strength and durability. The team could build in extra cycles on the front end of the process and still achieve all required delivery deadlines. This provided critical performance enhancements that improved the competitiveness of the car.

Beating the competition starts in the factory

Most Formula One teams start their design process in analysis to take advantage of the analysts' experience in predicting loads and designing parts that improve racing car performance. But, until now, teams did not have a consistent way of transferring data between their state-of-the-art software tools. By using Fibersim software across the conceptual and detailed design process, the Renault F1 Team proved once again the competitiveness of its design team. The Renault F1 Team questions every traditional design process in the factory to gain fractions of seconds on the racing circuit. The use of Fibersim has been instrumental in these efforts to optimize car performance and stay ahead of the pack.

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